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EXAMINER	
DIAMOND, ALAN D	

ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 10/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/885,319	STAN ET AL.	
	Examiner	Art Unit	
	Alan Diamond	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *6/24/04, 8/3/04, 6/6/05, 8/18/05*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *54-90* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *54-90* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 December 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. The Examiner acknowledges that non-elected claims 91-97 have been cancelled.

Priority

2. The filing date of Provisional Application No. 60/212,552 provided by Applicant, i.e., June 19, 2000, does not match the filing date of record in the Office, i.e., June 20, 2000. The priority statement in the specification should be changed to reflect the correct filing date, June 20, 2000.

Oath/Declaration

3. The oath or declaration is defective. A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02.

> The oath or declaration is defective because: the filing date of Provisional Application No. 60/212,552 provided in the Declaration does not match Office records. Office records show a filing date of June 20, 2000, whereas said Declaration recites a filing date of June 19, 2000.

4. The Examiner notes that Applicant filed a Request for Corrected Filing Receipt on May 19, 2003 in order to change the filing date of said Provisional Application on the instant filing receipt from June 20, 2000 to June 19, 2000. As noted in the Response to Request for Corrected Filing Receipt mailed May 27, 2003, the filing date of a parent application cannot be changed by said Request filed May 19, 2003. As noted in said Response mailed May 27, 2003, a petition to correct the filing date in the parent application (60/212,552) is required.

Claim Objections

5. Claims 71 and 83 objected to because of the following informalities: In claim 71, at line 2, the semicolon after InGaP should be changed to a comma. In claim 83, at line 4, the term "a upper" should be changed to "an upper". Appropriate correction is required.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

7. Claims 54-73 and 83-90 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claims contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In claim 54, at line 3, the term "a layer of material including In and P" is not supported by the specification, as originally filed. The same applies to dependent claims 55-64. The disclosure, as originally filed, does support an InGaP layer and an InP layer (see, for example, original page 6, lines 17-20). However, a layer of InGaP and a layer of InP are not sufficient support for the broader term "a layer of material including In and P". In other words, InGaP and InP are not sufficient support for any layer including In and P.

In claim 65, at line 3, the range "at least in part" for the GaAs is not supported by the specification, as originally filed. The same applies to dependent claims 66-73.

In claim 83, at line 2, a generic "upper subcell structure including arsenic (As)" is not supported by the specification, as originally filed. The same applies to dependent claims 84-90.

In claim 83, at lines 2-3, a generic "lower subcell formed from a p-type material including first and second diffusion sublayers" is not supported by the specification, as originally filed. The same applies to dependent claims 84-90.

In claim 83, at lines 4-5, the range "at least a portion" with respect to the second diffusion sublayer being disposed deeper into the p-type material than the first diffusion sublayer, is not supported by the specification, as originally filed. The same applies to dependent claims 84-90.

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claims 65-73, 79, 80, and 83-90 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 65 is indefinite because the term "said GaAs-containing layer" at line 5, and the term "the GaAs-containing layer" at line 6 lack positive antecedent support in claim 65 itself. It is suggested that said term at line 5 be changed to "said solar subcell layer", and the term at line 6 be changed to "the solar subcell layer". The same applies to dependent claims 66-73.

Claim 67 is indefinite because it is not clear what is meant by the term "a n-type germanium". It is suggested that said term be changed to "an n-type germanium layer".

Claim 79 is indefinite because the term "the junction" at line 1 lacks positive antecedent support in claim 79 itself. It is suggested that said term be changed to "a junction".

Claim 80 is indefinite because the term "the diffused phosphorus and arsenic" at lines 1-2 lacks positive antecedent support in claim 74. It is suggested that said term be changed to "diffused phosphorus and arsenic".

In claim 83, at line 3, it is not clear which photoactive junction is being referred to by the term "the photoactive junction". The same applies to dependent claims 84-90.

Claim 83 is indefinite because it is not clear where the "upper diffusion layer" at line 4 is located in the solar cell, and where it is located with respect to the first and second diffusion sublayers. The same applies to dependent claims 94-90.

In claim 84, at line 3, the word "atoms" should be inserted after "(As)".

Claim 85 is indefinite because "the top layer" at line 3 lacks positive antecedent support in claim 83. Furthermore, it is not clear which subcell is being referred to by the term "the subcell" at line 3 of claim 85. It is suggested that the term "the top layer of the subcell" at line 3 of claim 85 be changed to "a top layer of the lower subcell".

Claim Rejections - 35 USC § 102

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent

> granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

11. Claims 54, 59, 61, and 64 are rejected under 35 U.S.C. 102(b) as being anticipated by Ringel et al (U.S. Patent 5,571,339).

Ringel et al teaches a solar cell comprising a germanium (Ge) substrate and a layer of InP disposed directly on the Ge substrate (see col. 3, lines 36-39; and claim 10 at col. 9).

With respect to claim 59, it is the Examiner's position that the layer of InP has a lattice parameter "substantially equal to" the lattice parameter of the Ge substrate.

With respect to claim 61, it is the Examiner's position that Ringel et al's solar cell is capable of photoactively converting radiation ranging from approximately UV radiation to radiation having a wavelength of approximately 1800 nm.

With respect to claim 64, it is the Examiner's position that Ringel et al's cell has 1 sun AM0 efficiencies in excess of 26%.

Since Ringel et al teaches the limitations of the instant claims, the reference is deemed to be anticipatory.

12. Claims 65-68 and 71 are rejected under 35 U.S.C. 102(b) as being anticipated by Chiang et al, Experimental Results of $GaInP_2$/GaAs/Ge Triple Junction Cell Development for Space Power Systems," 25th IEEE PVSC, May 13-17,1996, pages 183-186.

As seen in Figure 2 at page 184, Chiang et al teaches a triple junction solar cell having a germanium (Ge) substrate with a subcell formed therein with an n-type Ge

layer overlying a p-type Ge substrate, and wherein the n-type Ge layer is formed by diffusion of arsenic; and a GaInP back surface passivating layer formed beneath a GaAs middle subcell, wherein said GaInP layer reads on the instant barrier layer (see also the paragraph bridging pages 183 and 184). In particular, it is the Examiner's position that Chiang et al's GaInP layer will inherently prevent diffusion of arsenic from said middle GaAs cell into the Ge substrate. Since Chiang et al teaches the limitations of the instant claims, the reference is deemed to be anticipatory.

13. Claims 54-57, 59-67, 69, 71, and 72 are rejected under 35 U.S.C. 102(e) as being anticipated by Ermer et al (U.S. Patent 6,380,601).

Ermer et al discloses a multijunction solar cell having a germanium substrate (22) doped with an n-type dopant; a nucleation layer (34) comprising of indium gallium phosphide (InGaP), a second cell layer (36) of gallium arsenide (GaAs), and a third cell layer (44) of InGaP (see col. 2, line 53 to col. 4, line 46). The nucleation layer (34) is formed at a preferred thickness of 25 Angstrom to 500 Angstrom and has a lattice parameter at a desired degree of lattice matching to the substrate (22) either "matched, or selectively made non-matching" (see col. 3, lines 28-49). The solar cell of Ermer et al would inherently absorb radiation ranging from UV radiation to a wavelength of 1800 nm through the use of Ge, GaAs and InGaP layers. Phosphorous is the preferred n-type dopant in the Ge substrate 22 (see col. 3, line 1). The junction depth in the Ge substrate (22) ranges from 0.1 microns to 3 microns (see col. 3, lines 7-10).

As subsequent layers are formed, the nucleation layer (34) would control the diffusion of dopant atoms into the substrate (22). At the elevated temperatures at which

the semiconductor layers are formed, solid state diffusion of dopants, such as arsenic from the GaAs layer (36), would be controlled by the thickness of the nucleation layer (34). Ermer et al discloses that "the invention allows for better passivation of the germanium homojunction substrate and shallower doping profiles with better control over diffused dopant concentrations" (see col. 1, lines 63-66).

Since Ermer et al teaches the limitations of the instant claims, the reference is deemed to be anticipatory.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. Claims 54, 55, 59-61, and 64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ringel et al (U.S. Patent 5,571,339).

With respect to claim 54, Ringel et al teaches a solar cell comprising a germanium (Ge) substrate and a layer of InP disposed directly on the Ge substrate (see col. 3, lines 36-39; and claim 10 at col. 9). Alternatively, and with respect to claim 55, Ga_sIn_sP compositional steps or continuous grading, i.e., instant InGaP layer, can be between the InP and the Ge (see col. 3, lines 39-47).

With respect to claim 59, said Ga_sIn_sP compositional steps or continuous grading is used to lattice match the Ge substrate to the InP (see col. 3, lines 39-47).

With respect to claim 61, it is the Examiner's position that Ringel et al's solar cell is capable of photoactively converting radiation ranging from approximately UV radiation to radiation having a wavelength of approximately 1800 nm.

With respect to claim 64, it is the Examiner's position that Ringel et al's cell has 1 sun AM0 efficiencies in excess of 26%.

Ringel et al teaches the limitations of the instant claims, other than the difference which is discussed below.

Ringel et al does not specifically require that the Ga_sIn_sP compositional steps or continuous grading be present between the Ge substrate and the InP. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Ringel et al's solar cell such that said Ga_sIn_sP compositional steps or continuous grading is directly between the Ge substrate and the InP because such is clearly within the scope of Ringel et al's disclosure.

With respect to claim 60, Ringel et al does not specifically teach the thickness of its Ga_sIn_sP compositional steps or continuous grading. However, in the absence of anything unexpected, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined an appropriate thickness for Ringel et al's Ga_sIn_sP compositional steps or continuous grading, such as the thickness of equal to 350 Angstroms or less as here claimed, so that a working solar cell could be prepared.

16. Claims 54, 55, 59, 61, 64, 65, and 71 are rejected under 35 U.S.C. 103(a) as being unpatentable over Olson (U.S. Patent 5,342,453).

With respect to claims 54, 55, 65, and 71, Olson teaches a solar cell comprising a substrate that can be germanium (Ge), a $GaInP_2$ passivating layer in direct contact with the substrate; and a solar cell containing GaAs over the passivating layer (see col. 3, line 22 through col. 4, line 50; and claims 10, 11, and 15-17; and Figure 1). Said $GaInP_2$ passivating layer reads on the barrier layer in instant claims 65 and 71.

With respect to claim 59, it is the Examiner's position that said $GaInP_2$ passivating layer has a lattice parameter substantially equal to the lattice parameter of the Ge substrate.

With respect to claim 61, it is the Examiner's position that Olson's solar cell is capable of photoactively converting radiation ranging from approximately UV radiation to radiation having a wavelength of approximately 1800 nm

With respect to claim 64, it is the Examiner's position that Olson's solar cell has 1 sun AM0 efficiencies in excess of 26%.

Olson teaches the limitations of the instant claims, other than the difference which is discussed below.

Olson does not specifically require the Ge be used as the substrate since the substrate can be selected from three other substrates (see claims 10 and 15). However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Ge as the substrate in Olson's solar cell because such is clearly within the scope of Olson's disclosure.

17. Claims 60 and 72 are rejected under 35 U.S.C. 103(a) as being unpatentable over Olson as applied to claims 54, 55, 59-61, and 64 above, and further in view of

Friedman et al, "Back Surface Fields for $GaInP_2$ Solar Cells," IEEE, (1991), pages 358-360.

Olson, as relied upon for the reasons recited above, teaches the limitations of claims 60 and 72, the difference being that Olson does not specifically teach the thickness of its $GaInP_2$ passivating layer. Friedman teaches a $GaInP_2$ back surface field passivating layer having a thickness of 0.02 microns, i.e., 200 Angstroms (see the entire document, in particular Figure 1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Olson's $GaInP_2$ passivating layer such that it has a thickness of 200 Angstroms because such is a conventional thickness of a $GaInP_2$ passivating layer, as shown by Friedman et al.

18. Claims 65-68, 71, and 72 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al, Experimental Results of $GaInP_2$/GaAs/Ge Triple Junction Cell Development for Space Power Systems," 25th IEEE PVSC, May 13-17,1996, pages 183-186, in view of Friedman et al, "Back Surface Fields for $GaInP_2$ Solar Cells," IEEE, (1991), pages 358-360.

As seen in Figure 2 at page 184, Chiang et al teaches a triple junction solar cell having a germanium (Ge) substrate with a subcell formed therein with an n-type Ge layer overlying a p-type Ge substrate, and wherein the n-type Ge layer is formed by diffusion of arsenic; and a GaInP back surface passivating layer formed beneath a GaAs middle subcell, wherein said GaInP layer reads on the instant barrier layer (see also the paragraph bridging pages 183 and 184). In particular, it is the Examiner's position that Chiang et al's GaInP layer will inherently prevent diffusion of arsenic from

said middle GaAs cell into the Ge substrate. Chiang et al teaches the limitations of the instant claims, other than the difference which is discussed below.

Chiang et al does not specifically teach the thickness of its GaInP back surface field passivating layer, whereas said claim 72 specifies a thickness of 350 Angstroms or less. Friedman teaches a $GaInP_2$ back surface field passivating layer having a thickness of 0.02 microns, i.e., 200 Angstroms (see the entire document, in particular Figure 1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Chiang et al's GaInP back surface field passivating layer such that it has a thickness of 200 Angstroms because such is a conventional thickness of a GaInP back surface field passivating layer, as shown by Friedman et al.

19. Claims 65-68, 71, and 73 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al, Experimental Results of $GaInP_2$/GaAs/Ge Triple Junction Cell Development for Space Power Systems," 25th IEEE PVSC, May 13-17,1996, pages 183-186, in view of Stanbery (U.S. Patent 4,322,571).

As seen in Figure 2 at page 184, Chiang et al teaches a triple junction solar cell having a germanium (Ge) substrate with a subcell formed therein with an n-type Ge layer overlying a p-type Ge substrate, and wherein the n-type Ge layer is formed by diffusion of arsenic; and a GaInP back surface passivating layer formed beneath a GaAs middle subcell, wherein said GaInP layer reads on the instant barrier layer (see also the paragraph bridging pages 183 and 184). In particular, it is the Examiner's position that Chiang et al's GaInP layer will inherently prevent diffusion of arsenic from

said middle GaAs cell into the Ge substrate. Chiang et al teaches the limitations of the instant claims, other than the difference which is discussed below.

Chiang et al does not specifically teach the formation of a two-step diffusion profile in the Ge substrate. Stanbery discloses a method for forming a solar cell with a two-step diffusion profile. The solar cell has areas with a deep junction, which has a high thermal stability, an areas of shallow junctions, which have high light-to-electrical energy conversion efficiencies (col. 5, lines 64-68).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the solar cell of Chiang et al so as to use a two-step diffusion profile as taught by Stanbery because the two-step diffusion profile has high thermal stability and a high conversion efficiency.

20. Claims 65-71, 74-76, and 78-82 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al, Experimental Results of $GaInP_2$/GaAs/Ge Triple Junction Cell Development for Space Power Systems," 25th IEEE PVSC, May 13-17,1996, pages 183-186, in view of Wiesmann (U.S. Patent 4,634,605).

As seen in Figure 2 at page 184, Chiang et al teaches a triple junction solar cell having a germanium (Ge) substrate with a subcell formed therein with an n-type Ge layer overlying a p-type Ge substrate, and wherein the n-type Ge layer is formed by diffusion of arsenic; and a GaInP back surface passivating layer formed beneath a GaAs middle subcell, wherein said GaInP layer reads on the instant barrier layer (see also the paragraph bridging pages 183 and 184). In particular, it is the Examiner's position that Chiang et al's GaInP layer will inherently prevent diffusion of arsenic from

said middle GaAs cell into the Ge substrate. Chiang et al teaches the limitations of the instant claims, other than the difference which is discussed below.

Chiang et al does not specifically teach that its n-type Ge layer is formed by diffusion of phosphorous or both phosphorous and said arsenic. Wiesmann discloses the use of both arsenic and phosphorous in combination as an n-type dopant (col. 7, lines 21-25). The use of arsenic and phosphorous as n-type dopants is very well known in the art, and they are functional equivalents of each other.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the n-type dopant in the solar cell of Chiang et al so as to use phosphorous or both phosphorous and arsenic, as taught by Wiesmann, because phosphorous and arsenic are functional equivalents. With respect to claim 74 and its dependent claims, it would have been well within the skill of an artisan to have used, for example, much more phosphorous dopant than arsenic dopant, thus resulting in a higher concentration of phosphorous atoms than arsenic atoms throughout the diffusion region (including the upper portion has here claimed), which the expectation that an n-doped geranium diffusion layer would be obtained in a working solar cell.

21. Claims 72 and 77 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al in view of Wiesmann as applied to claims 65-71, 74-76, and 78-82 above, and further in view of Friedman et al, "Back Surface Fields for $GaInP_2$ Solar Cells," IEEE, (1991), pages 358-360.

Chiang et al in view of Wiesmann, as relied upon for the reasons recited above, teaches the limitations of claims 72 and 77, the difference being that Chiang et al does

not specifically teach the thickness of its GaInP back surface field passivating layer, whereas said claims 72 and 77 specify a thickness of 350 Angstroms or less. Friedman teaches a $GaInP_2$ back surface field passivating layer having a thickness of 0.02 microns, i.e., 200 Angstroms (see the entire document, in particular Figure 1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Chiang et al's GaInP back surface field passivating layer such that it has a thickness of 200 Angstroms because such is a conventional thickness of a GaInP back surface field passivating layer, as shown by Friedman et al.

22. Claims 83-86 and 88-90 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al in view of Wiesmann as applied to claims 65-71, 74-76, and 78-82 above, and further in view of Stanbery (U.S. Patent 4,322,571).

Chiang et al in view of Wiesmann, as relied upon for the reasons recited above, teaches the limitations of claims 83-86 and 88-90, the difference being that Chiang et al in view of Wiesmann does not specifically teach the formation of a two-step diffusion profile, i.e., first and second diffusion sublayers in the Ge substrate. Stanbery discloses a method for forming a solar cell with a two-step diffusion profile. The solar cell has areas with a deep junction, which has a high thermal stability, an areas of shallow junctions, which have high light-to-electrical energy conversion efficiencies (col. 5, lines 64-68).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the solar cell of Chiang et al in view of Wiesmann

so as to use a two-step diffusion profile as taught by Stanbery because the two-step diffusion profile has high thermal stability and a high conversion efficiency.

23. Claim 87 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al in view of Wiesmann and further in view of Stanbery as applied to claims 83-86 and 88-90 above, and further in view of Friedman et al, "Back Surface Fields for $GaInP_2$ Solar Cells," IEEE, (1991), pages 358-360.

Chiang et al in view of Wiesmann and further in view of Stanbery, as relied upon for the reasons recited above, teaches the limitations of claim 87, the difference being that Chiang et al does not specifically teach the thickness of its GaInP back surface field passivating layer, whereas said claim 87 specifies a thickness of 350 Angstroms or less. Friedman teaches a $GaInP_2$ back surface field passivating layer having a thickness of 0.02 microns, i.e., 200 Angstroms (see the entire document, in particular Figure 1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Chiang et al's GaInP back surface field passivating layer such that it has a thickness of 200 Angstroms because such is a conventional thickness of a GaInP back surface field passivating layer, as shown by Friedman et al.

24. Claims 54-72 and 74-82 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ermer et al (U.S. Patent 6,380,601) in view of Wiesmann (U.S. Patent 4,634,605).

Ermer et al discloses a multijunction solar cell having a germanium substrate (22) doped with an n-type dopant; a nucleation layer (34) comprising of indium gallium phosphide (InGaP), a second cell layer (36) of gallium arsenide (GaAs), and a third cell

layer (44) of InGaP (see col. 2, line 53 to col. 4, line 46). The nucleation layer (34) is formed at a preferred thickness of 25 Angstrom to 500 Angstrom and has a lattice parameter at a desired degree of lattice matching to the substrate (22) either "matched, or selectively made non-matching" (see col. 3, lines 28-49). The solar cell of Ermer et al would inherently absorb radiation ranging from UV radiation to a wavelength of 1800 nm through the use of Ge, GaAs and InGaP layers. Phosphorous is the preferred n-type dopant in the Ge substrate 22 (see col. 3, line 1). The junction depth in the Ge substrate (22) ranges from 0.1 microns to 3 microns (see col. 3, lines 7-10).

As subsequent layers are formed, the nucleation layer (34) would control the diffusion of dopant atoms into the substrate (22). At the elevated temperatures at which the semiconductor layers are formed, solid state diffusion of dopants, such as arsenic from the GaAs layer (36), would be controlled by the thickness of the nucleation layer (34). Ermer et al discloses that "the invention allows for better passivation of the germanium homojunction substrate and shallower doping profiles with better control over diffused dopant concentrations" (see col. 1, lines 63-66).

Ermer et al teaches the limitations of the instant claims, other than the difference which is discussed below.

Ermer et al does not specifically teach the use of arsenic or both phosphorous and arsenic in place of the phosphorous that is used to form the n-type dopant layer in its Ge substrate (22). Wiesmann discloses arsenic, phosphorous, or the use of both arsenic and phosphorous in combination as an n-type dopant (col. 7, lines 21-25). The

use of arsenic and phosphorous as n-type dopants is very well known in the art, and they are functional equivalents of each other.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the n-type dopant in the solar cell of Ermer et al so as to use arsenic or both phosphorous and arsenic, as taught by Wiesmann, because phosphorous and arsenic are functional equivalents. With respect to claim 74 and its dependent claims, it would have been well within the skill of an artisan to have used, for example, much more phosphorous dopant than arsenic dopant, thus resulting in a higher concentration of phosphorous atoms than arsenic atoms throughout the diffusion region (including the upper portion has here claimed), which the expectation that an n-doped geranium diffusion layer would be obtained in a working solar cell.

25. Claims 73 and 83-90 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ermer et al in view of Wiesmann as applied to claims 54-72 and 74-82 above, and further in view of Stanbery (U.S. Patent 4,322,571).

Ermer et al in view of Wiesmann, as relied upon for the reasons recited above, teaches the limitations of claims 73 and 83-90, the difference being that Ermer et al in view of Wiesmann does not specifically teach the formation of a two-step diffusion profile, i.e., first and second diffusion sublayers in the Ge substrate. Stanbery discloses a method for forming a solar cell with a two-step diffusion profile. The solar cell has areas with a deep junction, which has a high thermal stability, an areas of shallow junctions, which have high light-to-electrical energy conversion efficiencies (col. 5, lines 64-68).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the solar cell of Ermer et al in view of Wiesmann so as to use a two-step diffusion profile as taught by Stanbery because the two-step diffusion profile has high thermal stability and a high conversion efficiency.

Response to Arguments

26. Applicant's arguments filed August 3, 2004 have been fully considered but they are not persuasive.

Applicant argues that the Rule 1.131 Declaration filed August 3, 2004 establishes that the instant invention is invented prior to March 29, 1999, i.e., the U.S. filing date of Ermer et al. However, this argument is not deemed to be persuasive for the following reasons:

Firstly, said Declaration is defective because a Rule 1.131 Declaration must be executed by all the inventors, i.e., by the applicants. Said 1.131 declaration is executed only be one of the instant inventors, Hong Q. Hou.

Secondly, said Declaration is defective because it does not state the place of execution. An affidavit is made under oath before an authorized official. The place of execution must be stated.

Thirdly, with respect to claim 54, the InGaP layer prepared as discussed in paragraph 7 of said Declaration is not sufficient support for a generic "layer of material including In and P". In other words, what is shown by the data in said Declaration is not commensurate in scope with what is being claimed. Indeed, a particular triple junction solar cell is prepared as seen in the data of said Declaration, and none of claim 54 and

its dependent claims are commensurate in scope with what is shown. Likewise, none of instant claims 65-90 are commensurate in scope with the particular triple junction solar cell prepared as seen in the data of said Declaration. Furthermore, none of the data in said Declaration show what is now recited in instant claims 65-90.

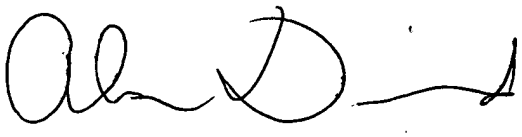
Fourthly, instant claims 54-73 and 83-90 contain new matter and have been rejected under 35 USC 112, first paragraph, as noted above in the instant Office action. Accordingly, they cannot even be afforded the instant filing date of June 19, 2001.

27. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alan Diamond whose telephone number is 571-272-1338. The examiner can normally be reached on Monday through Friday, 5:30 a.m. to 2:00 p.m. ET.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Alan Diamond
Primary Examiner
Art Unit 1753



Alan Diamond
October 24, 2005